



Aircraft Designer

Performance Task

Introduction

As an engineer, you are going to be designing, building and testing model airplanes. The purpose of your work is to experiment with different engineering ideas. You will need to find the best way to use and combine different materials to meet certain goals. The goal is to design three airplanes, one to fly the fastest, one to fly the farthest and one to fly the longest. There are several scientific factors related to motion that you could use. After your testing, you will then present your designs to a company that is interested in buying airplanes.

Big Idea / Essential Questions

Big Idea

- An object's motion is the result of all forces acting on it.
- Engineering design is a creative process that anyone can do which may result in new inventions and innovations.

Essential Questions

- What causes objects to move?
- What effect do the design elements have on the actual performance of a product?

G.R.A.S.P.

Goal

Your challenge is to use different engineering ideas to design airplanes. Your task is to design three model airplanes. Each of these planes needs to reach one of these goals:

- Flies the Fastest
- Flies the Farthest
- Flies the Longest

Role

You are a part of an engineering team that has been asked to work on a special airplane design project. You will need to think about many scientific ideas related to motion as you design. Principles such as Newton's Laws, friction, and gravity will assist you and your team in this process.

Audience

You will be designing, building, and testing your planes in class; your audience will be your peers. You will present your three designs to an airline company that is interested in designing new planes for their fleet.

Situation

As an engineer, you are going to be designing, building and testing model airplanes. The purpose of your work is to experiment with different engineering ideas. You will need to find the best way to use and combine different materials to meet certain goals. The goal is to design three airplanes: one to fly the fastest, one to fly the farthest and one to fly the longest. There are several scientific ideas related to forces and motion that you could think about when designing. After your testing, you will then present your designs to a company that is interested in designing new planes for their fleet.

- Step 1: Collect and review data and concepts related to motion and flight. Ideas such as physical properties, Newton's Laws, friction, gravity, and aerodynamics will be particularly useful.
- Step 2: Brainstorm and sketch your designs.
- Step 3: Build your plane. Your planes must match the designs mentioned in Step 2.
- Step 4: Test your planes. Collect data on the distance they fly and the time they are in the air. This will also help you determine speed. Refine your designs if necessary.
- Step 5: Present your findings. You will make a presentation for the airline company executives.
- Step 6: Create an advertisement. This will attract the airline companies to hire your engineering team to design new planes for them.
- The following website may be helpful as you brainstorm [Forces acting on planes](#)

The following resources may help you to create a design for your paper airplane:

[Paper Airplane Designs](#)

[Paper Airplanes HQ](#)

Products

1. Advertisement

You need to create an advertisement that could be given to the airline executives when they leave your presentation. This advertisement will help them remember what was special about your designs. You will need to highlight the specific features of your design. Why is it able to fly the farthest, fastest or longest? How is the design related to gravity? What materials do you recommend that your design be made from?

Include sketches of your 3 designs. Label the geometric shapes and properties of each. What geometric properties did they have in common and which were different? How did these shapes and properties influence the distance the plane traveled?

This advertisement can take any form you choose, including poster, handout, video, website, etc.

- What materials would you use to build an actual plane based on the models you created?
- What are some of the characteristics of your plane that make it special?
- How will you show your plane and briefly explain or tell about the important parts of its design?

Advertisement - Aircraft Designer

Achievement Levels	1	2	3	4
Effective Advertisement (x1)	An attempt is made to create an advertisement that addresses an audience and tells information about the plane(s).	Advertisement is partially effective because it somewhat addresses an audience and tells some information about the plane(s).	Advertisement is mostly effective because it addresses an audience, tells important information about the plane(s) and has a good choice of graphics.	Advertisement is effective because it addresses a specific audience, tells important information about the plane(s) and has excellent choice of graphics.
Engineering and Design (x1)	Product reflects little understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects some understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects strong understanding of the criteria and constraints related to size, materials and function of the design.
Layout (x1)	Attempt at balanced use of color and space. Information and graphics lack organization within the ad.	Attempt at balanced use of color and space. Information and graphics are partially organized within the ad.	Balanced use of color and space. Information and graphics are sufficiently organized within the ad.	Balanced use of color and space. Information and graphics are very well-organized within the ad.
Conventions (x1)	There are many errors in grammar, spelling or punctuation.	There are some errors in grammar, spelling or punctuation.	There are few errors in grammar, spelling or punctuation.	There are no errors in grammar, spelling or punctuation.
Forces and Motion (x1)	Product and explanation show little understanding that unbalanced forces acting on an object can cause a change in its state of motion.	Product and explanation show partial understanding that unbalanced forces acting on an object can cause a change in its state of motion.	Product and explanation show understanding that unbalanced forces acting on an object can cause a change in its state of motion.	Product and explanation show strong understanding that unbalanced forces acting on an object can cause a change in its state of motion.
Geometry (x1)	Few geometric shapes and properties are correctly labeled with an explanation of commonalities and differences using geometric terms.	Some geometric shapes and properties are correctly labeled with an explanation of commonalities and differences using geometric terms.	Most geometric shapes and properties are correctly labeled with an explanation of commonalities and differences using geometric terms.	All geometric shapes and properties are correctly labeled with an explanation of commonalities and differences using geometric terms.

2. Models

You will create three separate airplanes. One plane will need to fly the fastest. A second plane will need to fly the longest. A third plane will need to fly the farthest. Your models can be built out of any materials you have available (consider a combination of any of these materials: balsa wood, different types of paper, styrofoam, fiberglass, or card stock).

Begin by researching ideas related to forces and motion, shape, and symmetry, and then create sketches of your planes. Build each plane out of available materials and test them.

Once you have tested (thrown) each plane, measure the distance they traveled using number of feet and fraction of a foot. Make a chart that shows the distance each flew

and determine how much further each one flew than the other two. Which difference was greatest? Which was least?

- How can you create a plane that travels as fast as possible?
- How can you create a plane that travels the furthest distance?
- How can you create a plane that travels the longest time in the air?
- What role does gravity play in the way a plane flies?
- How do the shape or structure of different parts of a plane affect the way it flies?

Models - Aircraft Designer

Achievement Levels	1	2	3	4
Model (x1)	The model is inaccurate based on the plans. It has little attention to detail.	The model is somewhat accurately created based on the plans. It has some detail and some critical components.	The model is mostly accurately created based on the plans. It has attention to detail.	The model is accurately created based on the plans. It has great attention to detail.
Line Plot (x1)	Line plot is constructed in a way that makes the data difficult to read or interpret.	Line plot is somewhat correctly constructed using appropriate scale, labels and title.	Line plot is adequately constructed using appropriate scale, labels and title, and is relatively easy to read and analyze the displayed data.	Line plot is correctly constructed using appropriate scale, labels and title, and is easy to read and analyze the displayed data.
Engineering and Design (x1)	Product reflects little understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects some understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects strong understanding of the criteria and constraints related to size, materials and function of the design.
Developing Possible Solutions (x1)	Little research was done on the design problem before beginning to design solutions.	Some research was done on the design problem before beginning to design solutions.	Adequate research was done on the design problem before beginning to design solutions.	Thorough research was done on the design problem before beginning to design solutions.
Measurement (x1)	Few measurements are correctly expressed using number of feet and fractions of a foot.	Some measurements are correctly expressed using number of feet and fractions of a foot. Units are included.	Most measurements are correctly expressed using number of feet and fractions of a foot. Units are included.	All measurements are correctly expressed using number of feet and fractions of a foot. Units are included.
Testing Models (x1)	Student attempts to plan and carry out tests to gather data about distance, time and speed of the models.	Student(s) somewhat effectively planned and carried out tests to gather data about distance, time and speed of the models.	Student(s) mostly effectively planned and carried out tests to gather data about distance, time and speed of the models.	Student(s) effectively planned and carried out tests to gather data about distance, time and speed of the models.
Operations with Fractions (x1)	Product shows few of the correct fraction calculations of the difference in distances..	Product shows some of the correct fraction calculations of the difference in distances.	Product shows most of the correct fraction calculations of the difference in distances.	Product shows all correct fraction calculations of the difference in distances.

3. Multimedia Presentation

Create a presentation that you will give to the airline company executives. You must show them all parts of your brainstorming, design and modeling process. Include information about the design sketches, physical properties of the materials used (including mass, shape, volume, hardness and texture), models, data from the tests, and revised designs . You need to make sure that the audience understands exactly what you did and how you met the goal of the task so that they will be more likely to

hire your engineering team to help them design new planes. This presentation can be done using any technology available. Be sure to include images such as your sketches or tables and graphs that show the results of your tests.

- What choices did you make in the engineering design process and how can you show and tell people about those choices in your presentation?
- How will you organize all the information you have about your designs and the results of your tests in a way that makes sense to people?

Multimedia Presentation - Aircraft Designer

Achievement Levels	1	2	3	4
Line Plot Data (x1)	A very small amount data are correctly plotted on the line plot.	Some data are correctly plotted on the line plot.	Most data are correctly plotted on the line plot.	All data are correctly plotted on the line plot.
Explanation (x1)	Student minimally explains the flight data and reasons why each flew the distance it did.	Student partially explains the flight data and reasons why each flew the distance it did.	Student satisfactorily explains the flight data and reasons why each flew the distance it did.	Student thoroughly explains the flight data and reasons why each flew the distance it did.
Line Plot Details (x1)	Line plot is constructed in a way that makes the data difficult to read or interpret.	Line plot is somewhat correctly constructed using appropriate scale, labels and title.	Line plot is adequately constructed using appropriate scale, labels and title, and is relatively easy to read and analyze the displayed data.	Line plot is correctly constructed using appropriate scale, labels and title, and is easy to read and analyze the displayed data.
Geometry (x1)	Few geometric shapes and properties are correctly labeled with an explanation of commonalities and differences using geometric terms.	Some geometric shapes and properties are correctly labeled with an explanation of commonalities and differences using geometric terms.	Most geometric shapes and properties are correctly labeled with an explanation of commonalities and differences using geometric terms.	All geometric shapes and properties are correctly labeled with an explanation of commonalities and differences using geometric terms.

4. Virtual Field Trip To An Aircraft Museum

Create a virtual field trip that shows a variety of aircrafts from around the world. Be sure to include airplanes that can fly extremely long distances, fly very fast, and maneuver in a unique way. As part of this virtual field trip, make sure you include details about the way each plane is designed. What special features does each plane have and how do those help it fly far or fast? This virtual field trip may be helpful to you and your team as you brainstorm the way you want to design your planes.

- What are some characteristics of planes and why do these characteristics make them special?
- How are some planes similar to each other and different from one another?
- How have planes changed throughout history?

Virtual Field Trip To An Aircraft Museum - Aircraft Designer

Achievement Levels	1	2	3	4
Focus (x1)	Virtual field trip has little focus and the flow makes it challenging for the audience to follow.	Virtual field trip is partially organized, focused and the flow somewhat makes sense to the audience.	Virtual field trip is organized, focused and the flow mostly makes sense to the audience.	Virtual field trip is very organized, focused and the flow makes sense to the audience.

Achievement Media Levels Integration (x4)	1 Little of the media used, such as photos, video and sound, tightly connect to the purpose of the product.	2 Some media used, such as photos, video and sound, tightly connect to the purpose of the product.	3 Most media used, such as photos, video and sound, tightly connect to the purpose of the product.	4 All media used, such as photos, video and sound, tightly connect to the purpose of the product.
Conventions (x1)	Many errors in grammar, spelling or punctuation.	Some errors in grammar, spelling or punctuation	Few errors in grammar, spelling or punctuation.	No errors in grammar, spelling or punctuation.
Engineering and Design (x1)	Product reflects little understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects some understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects understanding of the criteria and constraints related to size, materials and function of the design.	Product reflects strong understanding of the criteria and constraints related to size, materials and function of the design.
Forces and Motion (x1)	Product and explanation show little understanding that unbalanced forces acting on an object can cause a change in its state of motion.	Product and explanation show partial understanding that unbalanced forces acting on an object can cause a change in its state of motion.	Product and explanation show understanding that unbalanced forces acting on an object can cause a change in its state of motion.	Product and explanation show strong understanding that unbalanced forces acting on an object can cause a change in its state of motion.
Content (x1)	Product provides very little explanation of the characteristics of the planes and why they were included.	Product provides a partial explanation of the characteristics of the planes and why they were included.	Product provides a mostly complete explanation of the characteristics of the planes and why they were included.	Product provides complete, deatiled explanation of the characteristics of the planes and why they were included.

5. Line Plot

Once you have tested all of your models and you recorded the flight lengths in feet and fraction of a foot, you will be creating a line plot of the distances. For this product, you will gather flight information from ***at least*** one other group, and include it with yours. What conclusions can you reach from the data? What is the median and mode of the data your dispalyed?

Line Plot

Achievement Levels	1	2	3	4
Line Plot Organization (x1)	Line Plot is not very organized and includes limited accurate information.	Line Plot is somewhat organized and includes some accurate information.	Line Plot is organized and includes information with all required elements.	Line Plot is very organized and includes accurate information with all required elements.
Fractions (x1)	Few distances are correctly shown and graphed using fractions.	Some distances are correctly shown and graphed using fractions.	Most distances are correctly shown and graphed using fractions.	All distances are correctly shown and graphed using fractions.
Displayed Data (x1)	Minimal data is accurately displayed on the line plot.	Some data is accurately displayed on the line plot.	Most data is accurately displayed on the line plot.	All data is accurately displayed on the line plot.
Conclusions Based on Data (x1)	Product shows few correct conclusions based on the data including measures of center.	Product shows some correct conclusions based on the data including measures of center.	Product shows satisfactory conclusions based on the data including measures of center.	Product shows all correct conclusions based on the data including measures of center.